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# Sleep Quality, Stress, and Mental Health in College Students: The Protective Role of Optimism and Critical Thinking

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**Abstract**

Mental health among university students is an issue of growing global concern, impacting both psychological well-being and academic outcomes. This study investigated the relationships between sleep quality, perceived stress, anxiety, and depression, examining the mediating role of perceived stress and the protective effects of optimism and critical thinking. A sample of 363 Italian university students (mean age = 22.67 ± 4.64 years) completed standardized self-report questionnaires assessing the main psychological variables of interest. Data were analyzed using structural equation modeling (SEM) with bootstrapping to evaluate mediating and moderating effects. SEM analyses showed that perceived stress partially mediated the effect of sleep disturbances on anxiety ($\beta = 0.27$, 95% CI [0.18, 0.37]) and depression ($\beta = 0.24$, 95% CI [0.16, 0.33]). Moreover, the impact of sleep problems on perceived stress was attenuated among students with higher levels of optimism ($\beta = -0.18$, $p = 0.003$) and critical thinking ($\beta = -0.14$, $p = 0.01$), confirming the protective role of these personal resources. These findings highlight the importance of considering both risk factors and protective resources in understanding and preventing psychological distress in university populations, suggesting interventions aimed at improving sleep quality and enhancing individual resources.

**Keywords:** sleep quality; stress; mental health; optimism; critical thinking; college students

## 1. Introduction

Mental health has emerged as a major global concern, particularly among young adults, for whom the process of adapting to new personal, social, and academic challenges can represent a significant source of stress [1–3]. Disorders such as anxiety, stress, and depression are steadily increasing and pose a substantial threat to psychological well-being and quality of life, with far-reaching consequences at both the individual and societal levels [4–6].

Within this context, university students represent a particularly vulnerable population. Numerous studies have documented higher levels of psychological distress in this age group compared to the general population, attributed to a range of factors such as academic pressure, uncertainty about the future, and lifestyle changes [7–9]. Recent data from an Italian context indicate that approximately 33% of university students report symptoms of anxiety and 27% report symptoms of depression, with negative consequences that may include social withdrawal, decreased academic performance, and, in more severe

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cases, university dropout [10,11]. These data underscore the urgency of advancing our understanding of the risk and protective factors influencing university students' mental health, with the aim of developing targeted interventions and effective support strategies.

### *1.1. Risk Factors*

Among the risk factors, perceived stress emerges as one of the primary psychological vulnerabilities among university students [12,13]. This stress stems not only from academic demands but also from uncertainty about the future, competitiveness, and social pressure to achieve success [14,15]. A substantial body of research has demonstrated that perceived stress is closely associated with anxiety, which may act as a mediator in the relationship between stress and depression, thereby amplifying the negative impact on mental health [16–18].

Another critical factor is sleep quality, which has been consistently shown to be strongly related to mental health outcomes [19,20]. Numerous studies have indicated that poor sleep quality predicts higher levels of stress, emotional dysregulation, depressive symptoms, and reduced cognitive and academic performance [21–23]. Sleep deprivation or fragmentation significantly undermines psychological resilience, increasing vulnerability to mood disorders and compromising overall well-being [24,25].

Intolerance of uncertainty—defined as the tendency to respond negatively or maladaptively to ambiguous, unpredictable, or uncontrollable situations—also constitutes a significant psychological vulnerability [26–28]. This cognitive trait, extensively studied in relation to anxiety disorders, has proven particularly salient in contexts of prolonged instability, such as the COVID-19 pandemic [29–31]. Within such scenarios, protective factors such as optimism and hope have been shown to support students' subjective well-being, highlighting the critical role of positive psychological resources in buffering the impact of uncertainty [32–34].

The presence of maladaptive coping strategies—such as avoidance, rumination, or substance use—should not be underestimated, as these behaviors can exacerbate psychopathological symptoms [35]. The adoption of such strategies is often associated with low self-esteem and poor emotional awareness [36,37].

### *1.2. Protective Factors*

Considering these risks, research has identified several protective factors that can promote mental health among university students. One of the most prominent is dispositional optimism, defined as the stable tendency to expect positive outcomes in the future [38,39]. Optimism has been associated with better psychological adjustment, reduced levels of anxiety and depression, and more effective use of active coping strategies [40–42]. In contexts characterized by uncertainty, such as the COVID-19 pandemic, optimism has proven to be a powerful protective factor, mitigating the negative impact of stress and fostering positive emotions and life satisfaction [43,44].

Another important protective factor is good sleep quality. Adequate sleep not only contributes to physical well-being, but also supports emotional balance, stress regulation, and cognitive functioning [45]. Students who maintain regular and restorative sleep patterns tend to report lower levels of perceived stress and demonstrate better academic performance [46,47].

Finally, a less explored yet promising area concerns the role of critical thinking, defined as the ability to analyze and evaluate information and situations in a rational, reflective, and autonomous manner [48–51]. Traditionally studied within educational contexts, this cognitive skill is increasingly being recognized as a potential protective factor for psychological well-being. Several studies suggest that critical thinking may foster greater cognitive

flexibility, facilitate effective problem-solving, and support a more realistic, conscious, and constructive approach to everyday challenges [52–55]. Contributions by Halpern [56] and Facione [57] have highlighted the potential of critical thinking to enhance individuals' ability to cope adaptively with difficulties, thereby reducing the likelihood of impulsive or maladaptive responses and promoting more stable psychological functioning.

### *1.3. Theoretical Framework*

The study of risk and protective factors associated with university students' mental health is grounded in several theoretical frameworks from developmental and health psychology. Among the most influential is Lazarus and Folkman's [58] Transactional Model of Stress and Coping, which conceptualizes stress as the outcome of a dynamic interaction between the individual and their environment. This model centers on the process of appraisal, referring to the individual's subjective cognitive evaluation of an event as threatening or manageable. Within this framework, personal resources such as dispositional optimism, sleep quality, and cognitive competencies (e.g., critical thinking) can significantly influence stress appraisal and the selection of coping strategies, thereby helping to buffer the adverse effects of stressful experiences on mental health.

In addition to this model, Hobfoll's [59] Conservation of Resources (COR) Theory provides a complementary perspective, emphasizing that stress primarily results from the actual or anticipated loss of personal, material, or social resources. From this viewpoint, factors such as chronic academic stress, intolerance of uncertainty, and poor sleep quality can be understood as indicators of resource depletion or loss. Conversely, the presence of dispositional optimism or effective cognitive regulation—such as that facilitated by critical thinking—can serve as protective reserves, mitigating the risk of psychological deterioration

From the perspective of positive psychology, Fredrickson's Broaden-and-Build Theory [60] provides further interpretative insights. According to this theory, positive emotions—often fostered by traits such as dispositional optimism—serve to broaden an individual's repertoire of thoughts and behaviours, thereby facilitating the development of enduring personal resources such as resilience, social connectedness, and cognitive flexibility. In academic contexts, this suggests that more optimistic students are likely to exhibit greater adaptability, resilience, and the capacity to engage in adaptive coping strategies in response to stress and uncertainty [61].

An additional theoretical contribution is provided by Carver and Scheier's Self-Regulation Theory [62], which posits that optimism supports behavioural and motivational self-regulation, particularly during times of adversity. Students who hold positive expectations about the future are more likely to persist in their academic efforts, manage obstacles more effectively, and maintain greater emotional stability

Lastly, Cognitive-Behavioural Theory (CBT) offers a valuable framework for understanding the role of critical thinking as a psychological resource. Specifically, the cognitive processing of stressful events—when influenced by distortions such as catastrophizing or overgeneralization—can contribute to heightened anxiety and depressive symptoms [63]. Critical thinking, conceptualized as the ability to evaluate reality in a rational and reflective manner, thus represents an important protective factor, promoting more adaptive coping strategies and enhanced emotional regulation [56,57].

In summary, the integration of these theoretical models provides a comprehensive framework for understanding how protective factors (such as optimism, sleep quality, and critical thinking) and risk factors (such as stress, anxiety, depression, and intolerance of uncertainty) jointly contribute to the psychological well-being of university students. These theories offer not only a conceptual basis for interpreting empirical data, but also valuable

insights for the development of preventive interventions and mental health promotion strategies within academic settings.

### *1.4. Objective of the Study*

Although the literature has highlighted the importance of factors such as optimism, critical thinking, sleep quality, and intolerance of uncertainty for students' mental health, the mechanisms through which these dispositions interact remain poorly understood. Our study makes an original contribution by simultaneously integrating both risk and protective factors within a single structural equation model (SEM), overcoming the limitations of traditional bivariate analyses. The use of SEM with bootstrapping allows us to examine both indirect (mediating) and moderating effects, providing a deeper understanding of the mechanisms influencing stress, anxiety, and depression. In particular, this approach highlights how personal resources such as optimism and critical thinking can buffer the negative impact of poor sleep quality on psychological well-being, offering a significant contribution to the literature on university student well-being.

For these reasons, the present study aims to examine the joint influence of protective factors (optimism and critical thinking) and risk factors (sleep disturbances and intolerance of uncertainty) on university students' mental health, with the goal of providing insights useful for educational and psychological support interventions. The following hypotheses are proposed:

**H1.** *Students with higher levels of optimism are expected to be associated with lower levels of perceived stress, anxiety, and depression.*

**H2.** *Students with greater critical thinking abilities are expected to be associated with lower levels of perceived stress, anxiety, and depression.*

**H3.** *Higher intolerance of uncertainty is expected to be associated with increased levels of perceived stress, anxiety, and depression.*

**H4.** *Poorer sleep quality is expected to be associated with higher levels of perceived stress, which in turn is associated with increased anxiety and depression (mediation model).*

**H5.** *Critical thinking is expected to moderate the association between intolerance of uncertainty and anxiety/depressive symptoms, attenuating its negative impact.*

## 2. Materials and Methods

### *2.1. Sample Size Estimation*

The sample size was determined through an a priori power analysis specifically tailored for path analysis models. Given the study's aim to examine the relationships among multiple psychological variables (optimism, critical thinking, intolerance of uncertainty, sleep quality, perceived stress, and mental health) using a SEM approach, the sample estimation considered the number of parameters to be estimated and the overall complexity of the model.

According to Cohen's [64] recommendations, to detect medium-sized effects ($f^2 = 0.15$; $r \approx 0.30$) under the assumption of normally distributed data, the model was expected to include approximately 20–25 parameters to be estimated, including regression weights, error terms, and variances/covariances among observed variables. Following the guidelines of West, Finch, and Curran [65] and Kline [66], which recommend a minimum ratio of 10 participants per estimated parameter in SEMs with normally distributed data, the re-

quired sample size was estimated to fall between 200 and 250 participants. This range was deemed sufficient to ensure a statistical power of ≥0.80 and stable parameter estimation.

This estimation is consistent with the recommendations of Wolf et al. [67], who suggest a sample size between 150 and 250 participants to detect medium-sized effects in SEMs comprising 4–6 latent variables and 12–24 indicators. Considering the potential for missing or invalid data, a minimum target sample of 220 participants was established.

### *2.2. Participants*

The study involved a total of 363 Italian university students, with a mean age of 22.67 years (SD = 4.64), ranging from 18 to 31 years. The sample was predominantly female, representing 76.9% of participants, while the remaining 23.1% consisted of male and non-binary students. Most participants were enrolled in health sciences programs (40.5%), followed by humanities (31.4%), natural sciences (8.8%), literature and the arts (8.5%), medicine (5.8%), economics and law (4.1%), and exercise sciences (0.8%).

With regard to academic performance, students reported an average university grade of 26.66 (SD = 2.21). In the Italian university grading system, grades range from 18 to 30, with 18 being the minimum passing grade and 30 representing the highest possible score. The mean high school final exam score was 86.20 (SD = 11.90), on a scale from 60 to 100, where 60 is the minimum passing grade. Overall, the sample can be considered representative of a heterogeneous student population in terms of academic field and performance level (see Table 1).

**Table 1.** Demographic and academic characteristics of the sample.

| Characteristics | Value | N (%) |
|---|---|---|
| Age | M ± SD | 22.67 (4.64) |
| Gender | Male | 78 (21.5) |
| | Female | 279 (76.9) |
| | Nonbinary | 6 (1.7) |
| Degree Course | Healthcare Professions | 147 (40.5) |
| | Medicine | 21 (5.8) |
| | Humanities | 114 (31.4) |
| | Natural Sciences | 32 (8.8) |
| | Literature and Humanities | 31 (8.5) |
| | Economics and Law | 15 (4.1) |
| | Motor Sciences | 3 (0.8) |
| University Grade | M ± SD | 26.66 (2.21) |
| High School Grade | M ± SD | 86.20 (11.90) |

### *2.3. Procedure*

Participants were recruited through the dissemination of a link to the online questionnaire, which was shared via various digital channels targeting university students, including official mailing lists, university-related social media groups, and dedicated student forums. This approach enabled access to a broad spectrum of students enrolled in different academic programs, ensuring sample diversity. The link directed participants to the Google Forms platform, where they could complete the questionnaire anonymously and independently. Data were collected from January to March 2025. To be included in the study, participants had to fulfill the following criteria: be enrolled in an Italian university, be at least 18 years of age, provide digital informed consent, and complete the online questionnaire. Individuals who did not meet these requirements were excluded from the study.

The research was carried out following the principles of the Declaration of Helsinki and received approval from the Ethics Committee of the University of Messina (protocol code 157, 27 February 2024). Prior to participation, students were provided with detailed information regarding the aims of the study, the procedures involved, and assurances of data privacy and confidentiality. Access to the questionnaire items was granted only after participants explicitly provided their consent through a designated introductory section of the survey.

### *2.4. Measurement*

#### 2.4.1. Revised Life Orientation Test

Optimism was assessed using the Revised Life Orientation Test (LOT-R) [68,69], which consists of 10 items: 3 positively worded items (e.g., "I am always optimistic about my future"), 3 negatively worded items (e.g., "I rarely count on good things happening to me"), and 4 filler items (e.g., "It is easy for me to relax"). Participants were asked to indicate their level of agreement with each statement on a 5-point Likert scale ranging from 0 (strongly disagree) to 4 (strongly agree). The total score ranges from 0 to 24, with higher scores indicating greater dispositional optimism. Although no definitive clinical cut-offs have been established, the literature proposes indicative thresholds: scores between 0 and 13 suggest low optimism, scores between 14 and 18 reflect a moderate level, and scores between 19 and 24 indicate high optimism. In the present sample of university students, internal consistency of the instrument, as measured by Cronbach's alpha, was 0.79.

#### 2.4.2. Pittsburgh Sleep Quality Index

Sleep quality over the past 30 days was assessed using the Pittsburgh Sleep Quality Index (PSQI) [70,71], a 19-item instrument that evaluates sleep habits across seven components: sleep duration, sleep latency, sleep disturbances, daytime dysfunction, use of sleep medication, habitual sleep efficiency, and overall sleep quality. The PSQI has been previously validated in university student populations [72]. Each component is rated on a scale from 0 to 3, yielding a global score ranging from 0 to 21. A total score greater than 5 is indicative of poor sleep quality. In the present study, the PSQI demonstrated good internal consistency, with a Cronbach's alpha of 0.83.

#### 2.4.3. Perceived Stress Scale

The Perceived Stress Scale (PSS) [73] is a 10-item questionnaire used to assess perceived stress over the past 30 days. Examples of items include: "In the last month, how often have you felt that you were unable to control the important things in your life?" and "In the last month, how often have you felt nervous and stressed?" Participants were asked to indicate how often they experienced specific thoughts and feelings using a 5-point Likert scale. Four of the items are positively worded and were reverse scored during analysis. The total score ranges from 0 to 40, with higher scores indicating greater levels of perceived stress. Previous studies conducted on university student populations have demonstrated good internal consistency for the instrument [74,75]. In the present study, the internal reliability, assessed using Cronbach's alpha, was 0.81.

#### 2.4.4. General Anxiety Disorder

To assess anxiety, the Generalized Anxiety Disorder-7 (GAD-7) [76] was employed. It is a self-report questionnaire consisting of 7 items, rated on a 4-point Likert scale (0 = not at all, 3 = nearly every day), measuring the frequency of anxiety symptoms over the past two weeks. Examples of items include: "Feeling nervous or anxious," "Not being able to control worrying," and "Trouble relaxing." The total score ranges from 0 to 21, with cut-offs of 5, 10, and 15 indicating mild, moderate, and severe anxiety, respectively.

The GAD-7 has demonstrated strong psychometric properties, with an internal consistency coefficient (Cronbach's alpha) of 0.89 in the general population [77]. In the present sample, the scale showed excellent internal reliability, with a Cronbach's alpha of 0.92.

#### 2.4.5. Patient Health Questionnaire

The Patient Health Questionnaire-9 (PHQ-9) [78] is a self-administered questionnaire used to assess the severity of depressive symptoms. The internal consistency of the PHQ-9 has been widely documented, with Cronbach's alpha values ranging from 0.81 to 0.84 [79,80]. The instrument consists of 9 items, each rated on a 4-point Likert scale (from 0 to 3), resulting in a total score ranging from 0 to 27. Participants are asked to indicate how often, over the past two weeks, they have been bothered by specific problems. Examples of items include: "Little interest or pleasure in doing things," "Feeling down, depressed, or hopeless," and "Trouble falling or staying asleep." Scores of 5, 10, 15, and 20 are considered clinical cut-offs indicating mild, moderate, moderately severe, and severe depression, respectively. In the present study, the PHQ-9 demonstrated excellent internal reliability, with a Cronbach's alpha coefficient of 0.90.

#### 2.4.6. Intolerance of Uncertainty Scale

The Intolerance of Uncertainty Scale–12 (IUS-12) [81], a short form of the original 27-item scale (IUS-27) [82], was used to assess intolerance of uncertainty. The IUS-12 measures two distinct dimensions: prospective anxiety and inhibitory anxiety. It consists of 12 items rated on a 5-point Likert scale (from 1 = not at all agree to 5 = completely agree), yielding a total score ranging from 12 to 60. Higher scores reflect greater intolerance of uncertainty. Examples of items include: "Unforeseen events upset me greatly" and "Uncertainty keeps me from living a full life." The validity and reliability of the IUS-12 have been confirmed in both clinical and non-clinical samples [83,84]. The Italian version of the scale demonstrated good internal consistency, with a Cronbach's alpha of 0.80 [85]. In the present study, the IUS-12 showed excellent internal reliability, with a Cronbach's alpha coefficient of 0.87.

#### 2.4.7. Critical Thinking Attitude Scale

The Critical Thinking Attitude Scale (CTAS) [86] was utilized to evaluate participants' propensity for analytical, evaluative, and metacognitive reflection. The scale includes 26 items divided across four subscales: "Systematicity" (9 items), "Search for Truth and Openness" (6 items), "Analyticity" (4 items), and "Inquisitiveness" (7 items). Responses were recorded on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores reflecting a more positive attitude toward critical thinking. Sample items include statements such as "I am able to think logically" and "I always try to delve deeper and understand things thoroughly." Cronbach's alpha coefficient was 0.87.

### *2.5. Statistical Analysis*

All statistical analyses were conducted using IBM SPSS Statistics (version 27) and IBM AMOS (version 24). Descriptive statistics (mean, standard deviation, range) were computed for all study variables. Subsequently, Pearson correlation analyses were performed to explore bivariate relationships among risk factors (e.g., sleep quality, intolerance of uncertainty), protective factors (e.g., optimism, critical thinking), and psychological outcomes (anxiety, depression, perceived stress). Missing data were handled using listwise deletion. Normality of the variables was assessed using Shapiro–Wilk tests and inspection of skewness and kurtosis.

To test the hypothesized theoretical model, a SEM analysis was conducted using the maximum likelihood estimation method and the bootstrapping technique (with 5000 samples) to assess the significance of indirect effects. Total scores of each scale

were used as observed variables rather than latent constructs. Model fit was evaluated using several goodness-of-fit indices: the chi-square statistic ($\chi^2$), the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). Values of CFI and TLI $\geq 0.90$, RMSEA $\leq 0.06$, and SRMR $\leq 0.08$ were considered indicative of a good model fit [87].

Finally, moderation effects were examined by creating mean-centered interaction terms between the predictors (sleep problems) and the moderators (optimism, critical thinking), which were subsequently included in the structural model. All predictors were mean-centered before creating interaction terms to reduce multicollinearity. Significant interactions were interpreted using simple slopes analyses to examine the nature of moderation. All statistical tests were two-tailed, and a *p*-value of less than 0.05 was considered indicative of statistical significance.

## 3. Results

Table 2 presents the descriptive statistics for the variables under analysis. The mean scores indicate impaired sleep quality and moderate levels of perceived stress within the sample. Similarly, the average levels of depressive and anxiety symptoms reflect a substantial presence of psychological distress among the students. Regarding intolerance of uncertainty, the mean values suggest a moderate level of difficulty in managing ambiguity. Finally, the results related to dispositional optimism and critical thinking indicate a limited availability of protective resources. Overall, the findings reveal marked interindividual variability in the psychological constructs examined.

**Table 2.** Descriptive statistics.

| Variables | M (±SD) | Range (Min–Max) |
|---|---|---|
| Sleep Quality | 9.72 (±3.36) | 2–20 |
| Perceived Stress | 22.14 (±6.43) | 3.00–39.00 |
| Depression | 9.48 (±5.49) | 0.00–25.00 |
| Anxiety | 9.76 (±5.04) | 0.00–21.00 |
| Intolerance of Uncertainty | 33.68 (±9.08) | 12.00–60.00 |
| Optimism | 12.63 (±4.11) | 3.00–23.00 |
| Critical Thinking | 89.34 (±18.76) | 38.00–127.00 |

Note. N = 363 for all variables.

Table 3 reports the results of the correlation analysis, which revealed significant associations among the variables examined, in line with the theoretical hypotheses regarding the role of risk and protective factors in the mental health of university students.

**Table 3.** Correlations among psychological variables.

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. |
|---|---|---|---|---|---|---|---|
| 1. Sleep Quality | - | | | | | | |
| 2. Anxiety | 0.441 ** | - | | | | | |
| 3. Depression | 0.547 ** | 0.726 ** | - | | | | |
| 4. Intolerance of Uncertainty | 0.326 ** | 0.631 ** | 0.591 ** | - | | | |
| 5. Stress | 0.416 ** | 0.735 ** | 0.632 ** | 0.551 ** | - | | |
| 6. Optimism | −0.283 ** | −0.529 ** | −0.511 ** | −0.503 ** | −0.587 ** | - | |
| 7. Critical Thinking | −0.111 * | −0.291 ** | −0.295 ** | −0.287 ** | −0.323 ** | 0.375 ** | - |

* $p < 0.05$, ** $p < 0.01$.

Specifically, sleep problems were positively associated with all indicators of psychological distress: anxiety ($r = 0.441$, $p < 0.001$), depression ($r = 0.547$, $p < 0.001$), perceived stress ($r = 0.416$, $p < 0.001$), and intolerance of uncertainty ($r = 0.326$, $p < 0.001$), indicating that sleep problems are associated with higher levels of psychological symptomatology. Similarly, intolerance of uncertainty showed positive associations with anxiety ($r = 0.631$, $p < 0.001$), depression ($r = 0.591$, $p < 0.001$), and perceived stress ($r = 0.551$, $p < 0.001$), confirming its relevance as a key variable in the psychological risk profile. With regard to protective factors, both optimism and critical thinking showed negative correlations with all indicators of psychological distress. Optimism was inversely associated with anxiety ($r = -0.529$, $p < 0.001$), depression ($r = -0.511$, $p < 0.001$), stress ($r = -0.587$, $p < 0.001$), intolerance of uncertainty ($r = -0.503$, $p < 0.001$), and sleep problems ($r = -0.283$, $p < 0.001$), highlighting its potential protective role. Critical thinking also demonstrated inverse associations with anxiety ($r = -0.291$, $p < 0.001$), depression ($r = -0.295$, $p < 0.001$), stress ($r = -0.323$, $p < 0.001$), and intolerance of uncertainty ($r = -0.287$, $p < 0.001$), and a weaker yet significant association with sleep problems ($r = -0.111$, $p = 0.034$), suggesting that greater analytical thinking ability may be linked to better emotional regulation. Finally, strong intercorrelations were observed between perceived stress, anxiety ($r = 0.735$, $p < 0.001$), and depression ($r = 0.632$, $p < 0.001$). These findings are consistent with the hypothesis of a potential mediating role of stress in the relationships between risk factors and psychological symptoms, a hypothesis further explored through structural analysis.

The results of the SEM analysis, conducted using a bootstrapping procedure to estimate the significance of indirect effects, indicate a good fit of the model to the data: $\chi^2(120) = 150$, $p = 0.05$; CFI = 0.95; TLI = 0.94; RMSEA = 0.05; SRMR = 0.04. As expected, sleep problems had a positive and significant direct effect on perceived stress ($\beta = 0.42$, $p < 0.001$), which in turn significantly predicted both anxiety ($\beta = 0.63$, $p < 0.001$) and depression ($\beta = 0.57$, $p < 0.001$). The direct effects of sleep problems on anxiety ($\beta = 0.21$, $p < 0.01$) and depression ($\beta = 0.29$, $p < 0.001$) remained significant, indicating a partial mediation. The indirect effect of sleep problems on anxiety through perceived stress was significant ($\beta = 0.27$, 95% CI [0.18, 0.37]), as was the indirect effect on depression ($\beta = 0.24$, 95% CI [0.16, 0.33]). In addition, the moderating effect of optimism on the association between sleep problems and perceived stress was tested. The Sleep Quality × Optimism interaction was significant ($\beta = -0.18$, $p = 0.003$), suggesting that higher levels of optimism buffer the negative impact of sleep problems on stress. A simple slopes analysis confirmed that the effect of sleep problems on perceived stress was weaker among students with high levels of optimism. A similar moderating effect was found for critical thinking: the interaction between sleep quality and critical thinking was significant ($\beta = -0.14$, $p = 0.01$), indicating that higher levels of critical thinking attenuate the impact of sleep disturbances on perceived stress. Overall, the model highlights that sleep problems are associated with students' mental health both directly and indirectly through perceived stress, and that this association is attenuated by the presence of personal resources such as optimism and critical thinking.

## 4. Discussion

The present study investigated the relationships among sleep quality, perceived stress, anxiety-depressive symptoms, intolerance of uncertainty, and protective resources—namely dispositional optimism and critical thinking—in a sample of university students.

The hypotheses, grounded in prior literature, were largely supported. The results for H1 indicated that students with higher levels of optimism were associated with lower levels of perceived stress, anxiety, and depression, consistent with the protective role of dispositional optimism described in Scheier and Carver's model [39]. Similarly, H2 was supported, as students with greater critical thinking abilities were associated with lower

levels of perceived stress, anxiety, and depressive symptoms, suggesting that cognitive competence may function as a protective factor. H3 was also supported, with higher intolerance of uncertainty associated with elevated levels of perceived stress, anxiety, and depression, consistent with its association as a psychological risk factor. In line with H4, poorer sleep quality was associated with higher levels of perceived stress, anxiety, and depression, in accordance with previous studies identifying sleep as a transdiagnostic factor related to psychological distress [22,23]. Perceived stress partially mediated the association between sleep disturbances and anxiety–depressive symptoms, indicating a potential pathway through which sleep quality is linked to psychological well-being, while residual direct associations were also observed, suggesting that additional associations may exist beyond the stress-mediated relationship.

Particularly noteworthy were the moderating roles of optimism and critical thinking. Dispositional optimism was associated with a weaker relationship between sleep problems and perceived stress, consistent with its role as a protective resource. In line with H5, critical thinking was associated with an attenuated relationship between intolerance of uncertainty and anxiety–depressive symptoms, which may reflect a potential role of greater cognitive competence in supporting emotional regulation strategies and buffering against stress-related outcomes.

Among the strengths of this research is the adoption of an integrated model that simultaneously considers both risk and protective factors, allowing for a more nuanced understanding of the psychological dynamics among university students. The use of structural equation modeling with bootstrapping techniques also ensured robust estimation of indirect effects and interactions, thereby strengthening the methodological rigor of the findings.

Despite the promising findings, the study presents several important limitations. The cross-sectional design limits the ability to draw conclusions about the directionality of the observed associations. The exclusive use of self-report measures may have introduced response biases, such as social desirability or self-assessment errors. It is important to note that the sample consisted predominantly of female students (76.9%), which may have influenced the strength of the observed associations among stress, anxiety, depression, and personal resources. This gender distribution should be considered when interpreting the findings. Furthermore, the sample was composed solely of university students, which restricts the generalizability of the results to other populations. Finally, the model did not account for potential confounding variables or additional mediators—such as emotion regulation or social support—that could further inform the understanding of the psychological processes involved.

Future studies should employ longitudinal designs to clarify the causal relationships between sleep quality, stress, and psychopathological symptoms. The integration of objective methodologies, such as sleep monitoring through actigraphy, could enhance data validity. Additionally, it would be valuable to explore the influence of further moderating and mediating factors—such as emotion regulation, resilience, and social support—to better understand the complex networks of protection and vulnerability. Comparative studies across different academic populations could also help identify cultural and contextual factors influencing the observed dynamics.

The findings underscore the importance of multidimensional interventions aimed at improving sleep quality and strengthening protective psychological resources such as optimism and critical thinking. These interventions could be implemented within university psychological support services through sleep education programs, stress management techniques, and metacognitive training designed to foster reflective thinking and a positive outlook on the future [88–90]. Such integrated approaches may contribute to reducing

the risk of developing anxiety and depressive disorders in high-risk populations such as university students.

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**Data Availability Statement:** The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

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